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(54) AIR ELECTRODE COLLECTOR FOR SOLID ELECTROLYTE TYPE FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an air electrode collector for a solid electrolyte type fuel cell which can be operated with efficiency at temperature below 1,000°C, and a solid electrolyte type fuel cell incorporating the air electrode collector.

SOLUTION: Provided is an air electrode collector for the solid electrolyte type fuel cell consisting either of a silver porous body, a silver porous body with an oxide compound layer formed on the surface, a porous body of dispersion-strengthened silver with an oxide dispersed in base silver, or a porous body of an alloy with superior high temperature strength than silver on which at least one side is silver-plated as well as a solid electrolyte type fuel cell incorporating it in plural number.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] Even if it operates this invention at low temperature, it relates to the solid oxide fuel cell incorporating the air pole charge collector in a high solid oxide fuel cell and this air pole charge collector of power density.

[0002]

[Description of the Prior Art] Generally, from the place which can use hydrogen gas, natural gas, a methanol, coal gas, etc. as a fuel, a solid oxide fuel cell can promote substitute-energies-for-petroleum-ization in a generation of electrical energy, and attracts attention also from a viewpoint of the place which can use waste heat further to a saving resources and an environmental problem. This solid oxide fuel cell has the laminated structure shown in the cross-section schematic diagram of drawing 1. In drawing 1, 1 is a slot where an air pole and the slot where in a solid electrolyte and 4 a fuel electrode charge collector passes along a fuel electrode and 6, and, as for a separator and 5, hydrogen passes [3] along 7 pass along an air pole charge collector and 2, and air passes along 8. The laminating of the air pole 2 is carried out to one side of a solid electrolyte 3, and a cel 9 is constituted by forming a fuel electrode 5 in one side of another side.

[0003] Although said solid electrolyte 3 generally consists of zirconias (henceforth YSZ) stabilized by yttria Recent-years and $\text{Ln}_{1-x}\text{A}_x\text{Ga}_{1-y}\text{ZB}_1\text{B-2O}_3$ (however, $\text{Ln}=\text{La}$) One sort or two sorts or more (one sort of Ce, Pr, Nd, and Sm or two sorts or more, $\text{A}=\text{Sr}$, and calcium and Ba), The oxide shown by one sort of one sort of $\text{B}_1=\text{Mg}$, and aluminum and In or two sorts or more, $\text{B-2}=\text{Co}$, and Fe, nickel and Cu or two sorts or more, $x=0.05$ to 0.3 , $y=0$ to 0.29 , $z=0.01$ to 0.3 , and $y+z=0.025-0.3$ is used. Furthermore, the separator 4 consists of precise ceramics which consists of lanthanum chromite (LaCrO_3), the air pole 2 consists of ceramics, such as $\text{CoO}(\text{Sm}, \text{Sr})_3$ and $\text{MnO}(\text{La}, \text{Sr})_3$, and the fuel electrode 5 consists of a nickel/YSZ cermet, nickel/(Ce, Sm) O_2 cermet, etc. And the air pole charge collector 1 consists of platinum mesh, and the fuel electrode charge collector 6 consists of nickel mesh.

[0004]

[Problem(s) to be Solved by the Invention] However, although the conventional solid oxide fuel cell can transform comparatively efficiently into electrical energy the chemical energy which the fuel has by making it operate at the high temperature of 1000 degrees C In order to operate actuation of a solid oxide fuel cell at 1000 degrees C Especially the ingredient used for the component part of a solid oxide fuel cell is restricted to the ingredient excellent in thermal resistance. The attachment for furthermore operating a solid oxide fuel cell It is not avoided by constituting from an ingredient which bears [(in / for example, / the preheating equipment) of fuel gas etc.] an elevated temperature, and carrying out operating at high temperatures that cost -- consumption of an ingredient becomes early and a use life also becomes short -- becomes high. Therefore, the solid electrolyte fuel cell which can be operated efficiently is called for by whenever [low-temperature] rather than 1000 degrees C.

[0005]

[Means for Solving the Problem] this invention person etc. did test research that the solid electrolyte fuel cell which can be efficiently operated at still lower temperature from the above viewpoints should be developed. Consequently, the research result that its generating efficiency would improve by 1.6 or more times compared with the solid oxide fuel cell incorporating the air pole charge collector which consists of the conventional platinum mesh if the solid oxide fuel cell which incorporated the porous body which consists of silver which does not oxidize in a high-temperature-oxidation ambient atmosphere, but has good conductivity as an air pole charge collector is operated below 900 degrees C

was obtained.

[0006] This invention has the description in the air pole charge collector of a solid oxide fuel cell which is made based on this research result and consists of a (1) silver porous body.

[0007] Furthermore, the air pole charge collector of the solid oxide fuel cell of this invention may be an oxide adhesion porous body which made the oxide film etc. adhere to the front face of the silver porous body of the aforementioned (1) publication, and made the mechanical strength increase to it. The oxide adhering to the front face of said oxide adhesion porous body has an aluminum oxide, titanium oxide, silicon oxide, etc. Therefore, this invention has the description in the air pole charge collector of the solid oxide fuel cell in which the oxide film was formed on the front face of (2) silver porous body.

[0008] There is a role which functions as passage which passes the air which is oxidant gas as a role of the air pole charge collector of a solid oxide fuel cell. Therefore, as for the silver porous body used as an air pole charge collector of a solid oxide fuel cell, it is much more desirable that it is the dispersion-strengthening type silver porous body which was made to distribute an oxide and raised the mechanical strength in the silver base. Therefore, this invention has the description in the air pole charge collector of a solid oxide fuel cell which consists of a dispersion-strengthening type silver porous body which the oxide distributed in the base of (3) silver.

[0009] Although the oxide contained in the dispersion-strengthening type silver which oxide distributed in the base of said silver has tin oxide, indium oxide, lanthanum oxide, oxidization copper, chromic oxide, titanium oxide, an aluminum oxide, ferrous oxide, nickel oxide, a vanadium oxide, magnesium oxide, a calcium oxide, a strontium oxide, the barium oxide, etc., specifically, its tin oxide is the most desirable. As for the oxide contained in this dispersion-strengthening type silver, it is desirable that it is three to 50 capacity %, and under 3 capacity % of strengthening as an air pole charge collector of a solid oxide fuel cell is [that reason] inadequate, and on the other hand, if 50 capacity % is exceeded, the operation as an air pole charge collector falls, and since sufficient power density is not obtained, it will be based on the reason which is not desirable. And the outermost surface is silver substantially and, as for this dispersion-strengthening type silver porous body, it is much more desirable that the interior consists of dispersion-strengthening type silver.

[0010] The silver porous body or dispersion-strengthening type silver porous body which constitutes the air pole charge collector of the solid oxide fuel cell of this invention has the sponge structure which consists of a frame part (henceforth a skeleton), and pore, and if that porosity is 60 - 97%, it is enough. The silver porous body which constitutes the air pole charge collector of this invention is good in the direction where detailed pore does not exist in a skeleton, and when the detailed pore in a skeleton exists, it must be held down to less than 10% of the whole. It is because the reinforcement as an air pole charge collector will fall if translucent porosity comes to have 10% or more, so it is not desirable.

[0011] Silver is returned into an oxidizing atmosphere in about 200-degree-C or more temperature field 930 degrees C or less, and a metal phase is a stabilization phase. Therefore, an oxide film is not formed in about 200-degree-C or more temperature field 930 degrees C or less, but a silver porous body is a good conductor. However, if the solid acid ghost fuel cell incorporating the air pole charge collector which consists of a silver porous body is operated at 930 degrees C, an oxide film will not be generated on the front face of the air pole charge collector which consists of a silver porous body, but since oxygen is dissolved at an elevated temperature, silver begins to melt at about 930 degrees C. Therefore, as for the operating temperature of the solid acid ghost fuel cell which incorporated the silver porous body or the dispersion-strengthening type silver porous body as an air pole charge collector, it is actually desirable that it is 900 degrees C or less.

[0012] Generally, in an air pole, although reception and oxygen ion (O^{2-}) are generated by the air pole charge collector in an electron, the oxygen in air why the generation-of-electrical-energy engine performance of the solid acid ghost fuel cell which incorporated the silver porous body or the dispersion-strengthening type silver porous body as an air pole charge collector improves at low temperature When the silver with which the oxygen of ultralow volume is contained is used as the air pole charge collector of a solid acid ghost fuel cell, By the rise of the exchange current density of that there is work which ***** rare ***** makes promote generation of the oxygen ion in a current collection body surface, and oxygen ion can be early moved from a current collection body surface into a charge collector, a charge collector, and an electrode the air pole current collection which that migration of the further oxygen ion becomes prompt, dissociation ($O_2 \rightarrow 2O$) of oxygen, and ionization ($O + 2e^- \rightarrow O^{2-}$) also become from a silver porous body or a dispersion-strengthening type silver porous body -- it is thought that it is because it promotes by the oxygen which dissolved inside of the body.

[0013] The air pole charge collector of a solid oxide fuel cell which consists of a silver porous body can

add other components to silver, can produce a silver alloy, can produce the porous body which consists of a silver alloy, and can use it as the air pole charge collector of a solid oxide fuel cell. In order to use this silver alloy porous body as an air pole charge collector of a solid oxide fuel cell, the melting point must be the porous body of a silver alloy 600 degrees C or more (preferably 800 degrees C or more). This melting point: Although what kind of alloy is sufficient as long as it is a silver alloy 600 degrees C or more, you may be the silver alloy of a presentation with which below 40 mass % is contained in total, and the remainder consists one sort in Cu, Zn, Cd, nickel, Sn, Au, Pt, Pd, Ir, and Rh, or two sorts or more of Ag and an unescapable impurity also among these silver alloys.

[0014] a deer -- **** -- the air pole charge collector of a solid oxide fuel cell with which this invention consists of a silver alloy porous body beyond (4) melting-point:600 degree C, and (5) -- said silver alloy beyond melting point:600 degree C Below 40 mass % is contained for one sort in Cu, Zn, Cd, nickel, Sn, Au, Pt, Pd, Ir, and Rh, or two sorts or more in total. It has the features in the air pole charge collector of the solid oxide fuel cell of the aforementioned (4) publication which is the silver alloy of a presentation with which the remainder consists of Ag and an unescapable impurity.

[0015] It is because the catalysis which Ag has will fall if, as for the reason limited to below 40 mass % in total, these components contain one sort in Cu, Zn, Cd, nickel, Sn, Au, Pt, Pd, Ir, and Rh which are contained in a silver alloy, or two sorts or more exceeding 40 mass %, so it is not desirable.

[0016] It is much more desirable that it is the dispersion-strengthening type silver porous body which was made to distribute an oxide and raised the mechanical strength in the base of a silver alloy the above (4) and given in (5). therefore, this invention -- (6) -- said silver alloy beyond melting point:600 degree C Below 40 mass % is contained for one sort in Cu, Zn, Cd, nickel, Sn, Au, Pt, Pd, Ir, and Rh, or two sorts or more in total. It has the description in the air pole charge collector of a solid oxide fuel cell (4) which is the dispersion-strengthening type silver porous body which the oxide distributed in the silver alloy base of the presentation which the remainder becomes from Ag and an unescapable impurity, and given in (5).

[0017] Furthermore, the air pole charge collector of the solid oxide fuel cell of this invention may consist of a porous body of the metal which excelled silver in high temperature strength, or an alloy, and may consist of porous bodies which come to form a silver deposit in this porous body side which touches an air pole at least. For forming said silver deposit, nickel deposit is usually formed as a substrate layer, and a silver deposit is formed on this nickel plating substrate layer. And especially the plating approach for forming this nickel plating substrate layer and a silver deposit is not limited, and may be formed by what kind of plating approach. The metal or alloy which excelled said silver in high temperature strength It is desirable that they are nickel or nickel radical alloy, Fe, Fe radical alloy, Co, or Co alloy. There are pure nickel, Inconel 600, Hastelloy C-22, a HEINZU alloy 214, etc. as concrete nickel or a nickel radical alloy. It is pure Fe, carbon steel, stainless steel, S ITTO steel, etc. as Fe or a Fe radical alloy, and there are the HEINZU alloy 188, ULTET, etc. as Co or a Co alloy.

[0018] Therefore, this invention consists of a porous body of the metal which excelled (7) silver in high temperature strength, or an alloy. nickel plating substrate layer is formed in this porous body side which touches an air pole at least. the air pole charge collector of the solid oxide fuel cell which comes to form silver plating on it, and (8) -- the metal or alloy which excelled said silver in high temperature strength It has the features in the air pole charge collector of the solid oxide fuel cell of the aforementioned (6) publication which is nickel or nickel radical alloy, Fe, Fe radical alloy, Co, or Co alloy.

[0019] If the porosity of the porous body which the melting point which constitutes the air pole charge collector of the solid oxide fuel cell of this invention produced with the metal or alloy which excelled the silver alloy porous body and silver which it has 600 degrees C or more in high temperature strength is 60 - 97%, it is enough, it is good in the direction where detailed pore does not exist in a skeleton, and when the detailed pore in a skeleton exists, it must be held down to less than 10% of the whole. It is because the reinforcement as an air pole charge collector will fall if translucent porosity comes to have 10% or more, so it is not desirable.

[0020]

[Embodiment of the Invention] Below, an example explains concretely the air pole charge collector of the solid acid ghost fuel cell of this invention.

The virgin silver atomization powder which has mean-particle-diameter:2micrometer was prepared by dissolving example 1 virgin silver with the usual fusion furnace, and atomizing the obtained virgin silver molten metal. Furthermore, as an organic solvent, as n-hexane and a surface active agent, the hydroxypropyl methylcellulose (henceforth HPMC) was prepared as sodium dodecylbenzenesulfonate (henceforth DBS), and a water-soluble-resin binder, and the glycerol was prepared as a plasticizer,

respectively. Furthermore, distilled water was prepared as water.

[0021] After inserting said virgin silver atomization powder and HPMC (water-soluble-resin binder) in a strong shear mold kneading machine and kneading them for 30 minutes, 50% of distilled water of the total amount of distilled water which must be added is added and kneaded. By adding n-hexane (organic solvent), DBS (surfactant), and the glycerol (plasticizer) which are other additives in the further remaining 50% list of distilled water, and kneading in it for 3 hours Distilled water: mass % -- virgin silver atomization powder: -- 50.0%, n-hexane:1.5%, HPMC:5.0%, DBS:2.0%, and glycerol: -- 3.0%, since it remained, the mixed slurry of the becoming presentation was produced.

[0022] A :2mm Plastic solid is produced for this mixed slurry in thickness with a doctor blade method. This Plastic solid (i) foaming condition humidity:90%, temperature:35 degree C, holding-time:10 minutes, (ii) -- cleaning condition ambient atmosphere: -- air moderate temperature whenever: -- 450 degrees C and holding-time: -- for 60 minutes Produce the virgin silver porous body plate which had a thickness:1.5mm dimension by performing foaming, cleaning, and sintering on condition that 910 degrees C and holding-time:120-minute **, and it starts from this virgin silver porous body plate. (iii) sintering condition ambient atmosphere: -- air moderate temperature whenever: -- The air pole charge collector which consists of a virgin silver porous body which has the porosity shown in Table 1 was produced.

[0023] As raw material powder, furthermore, La_2O_3 , SrCO_3 , Ga_2O_3 , MgO , Prepare each powder of CoO , and weighing capacity of these raw material powder is carried out so that it may be set to $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_3$. After mixing well, by carrying out preliminary baking at 1100 degrees C, pulverizing the acquired temporary-quenching object, adding the usual binder, a solvent, etc. and grinding with a ball mill, the slurry was produced and this slurry was fabricated to the green sheet with the doctor blade method. The fabricated green sheet was fully dried in air, it started in the predetermined dimension, and this was sintered at 1450 degrees C. The thickness of the acquired sintering object was 110 micrometers.

[0024] Thus, use the acquired sintering object as an electrolyte and a fuel electrode is formed by baking the mixed powder of NiO and $\text{O}(\text{Ce}_{0.8}\text{Sm}_{0.2})_2$ mixed so that the volume ratio of nickel and $\text{O}(\text{Ce}_{0.8}\text{Sm}_{0.2})_2$ might be set to 6:4 on one side of this electrolyte at 1100 degrees C. The cel was produced by forming an air pole by furthermore baking $\text{CoO}(\text{Sm}_{0.5}\text{Sr}_{0.5})_3$ on one side of the opposite side of said electrolyte at 1000 degrees C.

[0025] Furthermore, after carrying out the hydrostatic-pressure press of the lanthanum chromite powder and considering as tabular, it machined, the slot was formed and the separator which has a slot on one side was produced by subsequently sintering at 1450 degrees C. Moreover, nickel felt was prepared as a fuel electrode charge collector.

[0026] Thus, this invention solid electrolyte fuel cell 1 which has the structure which carries out the laminating of the nickel felt which is a fuel electrode charge collector to the fuel electrode side of the produced cel, carries out the laminating of the air pole charge collector which is from said virgin silver porous body on the air pole side of a cel, is made to carry out the laminating of said separator further on these fuel electrode charge collector and an air pole charge collector, and is shown in drawing 1 was produced.

[0027] The solid electrolyte fuel cell 1 was conventionally produced completely like the example 1 except incorporating the air pole charge collector which prepares the air pole charge collector which consists of a platinum mesh, replaces with this invention air pole charge collector which consists of a virgin silver porous body of an example 1, and becomes conventional example 1 pan from said platinum mesh for a comparison.

[0028] Thus, holding a solid electrolyte fuel cell 1 at 700 degrees C the obtained this invention solid electrolyte fuel cell 1 and conventionally, as fuel gas, as a sink and oxidant gas, current density [in / for air / in desiccation hydrogen gas / 0.7V] was measured, and the result was shown in Table 1 about the solid electrolyte fuel cell 1 a sink, this invention solid electrolyte fuel cell 1, and conventionally, respectively.
 [0029]

[Table 1]

種別		空気極集電体		0.7Vにおける電流密度 (mA/cm ²)
		成分	気孔率 (%)	
本発明固体電解質型燃料電池	1	純銀	92	595
従来固体電解質型燃料電池	1	白金メッシュ		360

[0030] Compared with a solid electrolyte fuel cell 1, it turns out that the current density in 0.7V is improving sharply conventionally incorporating the air pole charge collector with which this invention solid electrolyte fuel cell 1 which incorporated the air pole charge collector which consists of a virgin silver porous body from the result shown in Table 1 consists of a platinum mesh produced in the conventional example 1.

[0031] SnO₂ powder which all has mean-particle-diameter:0.5micrometer of marketing as example dioxide powder, 2OIn₃ powder which has mean-particle-diameter:0.5micrometer, 2OLa₃ powder which has mean-particle-diameter:0.5micrometer, and mean particle diameter: 2OFe₃ powder which has 0.5 micrometers was prepared. To the virgin silver atomization powder prepared in the example 1, said SnO₂ powder, 2OIn₃ powder, Blend 2OLa₃ powder or 2OFe₃ powder, and the silver-oxide system dispersion-strengthening mold alloy powder which distributed the oxide inside by carrying out grinding mixing for 100 hours, and carrying out mechanical alloying with a ball mill is produced. The air pole charge collector which consists of a dispersion-strengthening type silver porous body which has the component presentation and porosity which are shown in Table 2 by fabricating and sintering on the same conditions as an example 1 using the obtained silver-oxide system dispersion-strengthening mold alloy powder is produced. this invention solid electrolyte fuel cells 2-5 which have the structure shown in drawing 1 like an example 1 by carrying out the laminating of the air pole charge collector which consists of these dispersion-strengthening type silver porous body to the air pole side of a cel are produced. About this invention solid electrolyte fuel cells 2-5, the current density in 0.7V was measured, respectively, and the result was shown in Table 2.

[0032]

[Table 2]

種別		分散強化型銀からなる空気集電体			0.7 Vにおける電流密度 (mA/cm ²)
		成分組成 (容量%)		気孔率 (%)	
		酸化物	Ag		
本発明固体電解質型燃料電池	2	SnO ₂ : 12	残部	91	578
	3	In ₂ O ₃ : 10	残部	92	581
	4	La ₂ O ₃ : 11	残部	91	585
	5	Fe ₂ O ₃ : 10	残部	95	555

[0033] Compared with the conventional solid electrolyte fuel cell 1 of Table 1 which produced this invention solid electrolyte fuel cells 2-5 which incorporated the air pole charge collector which consists of a dispersion-strengthening type silver porous body from the result shown in Table 2 in the conventional example 1, it turns out that the current density in 0.7V is improving sharply.

[0034] The air pole charge collector which consists of a virgin silver porous body produced in the example 3 example 1 is used as a base. The oxide adhesion air pole charge collector which 2Oaluminum₃ thickness:5micrometer coat was formed [charge collector] in the front face of this base with vacuum deposition, and made the mechanical strength increase to it is produced. this invention solid electrolyte fuel cell 6 incorporating the oxide adhesion air pole charge collector to which these mechanical strengths were made to increase is produced. As a result of measuring the current density in 0.7V about this this invention solid electrolyte fuel cell 6, the measured current density is 583 mA/cm², and it turns out that this value is improving sharply compared with the conventional solid electrolyte fuel cell 1 of Table 1 produced in the conventional example 1.

[0035] The silver alloy atomization powder which has the component presentation which all has mean-particle-diameter:1.5micrometer and is shown in Table 3 as example 4 silver-alloy powder was prepared. The air pole charge collector which consists of a silver alloy porous body which has the

component presentation and porosity which are shown in Table 3 by fabricating and sintering on the same conditions as an example 1 using these silver alloy atomization powder is produced. this invention solid electrolyte fuel cells 7-20 which have the structure shown in drawing 1 like an example 1 by carrying out the laminating of the air pole charge collector which consists of these dispersion-strengthening type silver porous body to the air pole side of a cel are produced. About this invention solid electrolyte fuel cells 7-20, the current density in 0.7V was measured, respectively, and the result was shown in Table 3.

[0036]

[Table 3]

種別		銀合金多孔質体からなる空気集電体												0.7 Vにおける電流密度 (mA/cm ²)
		成分組成 (質量%)											気孔率 (%)	
		Cu	Zn	Cd	Ni	Sn	Au	Pt	Pd	Ir	Rh	Ag		
本発明固体電解質型燃料電池	7	18	-	-	-	-	-	-	-	-	-	残部	93	551
	8	25	10	-	-	-	-	-	-	-	-	残部	93	555
	9	18	10	6	-	-	-	-	-	-	-	残部	93	590
	10	-	-	26	2	-	-	-	-	-	-	残部	90	560
	11	16	11	-	-	3	-	-	-	-	-	残部	96	556
	12	25	-	-	1	-	-	-	-	-	-	残部	92	571
	13	-	10	-	-	1	-	-	-	-	-	残部	94	562
	14	-	-	3	-	4	-	-	-	-	-	残部	91	585
	15	-	-	7	2	-	-	-	-	-	-	残部	91	570
	16	-	-	-	-	-	5	-	-	-	-	残部	93	588
	17	-	-	-	-	-	-	3	-	-	-	残部	91	587
	18	-	-	-	-	-	-	-	4	-	-	残部	94	585
19	-	-	-	-	-	-	-	-	2	-	残部	94	590	
20	-	-	-	-	-	-	-	-	-	1	残部	93	593	

[0037] From the result shown in Table 3, below 40 mass % is contained for one sort in Cu, Zn, Cd, nickel, Sn, Au, Pt, Pd, Ir, and Rh, or two sorts or more in total. Compared with the conventional solid electrolyte fuel cell 1 of Table 1 which produced this invention solid electrolyte fuel cells 7-20 incorporating the air pole charge collector which consists of a silver alloy porous body of the presentation which the remainder becomes from Ag and an unescapable impurity in the conventional example 1, it turns out that the current density in 0.7V is improving sharply.

[0038] By carrying out the laminating of the air pole charge collector which consists of a dispersion-strengthening mold silver alloy porous body which has the component presentation and porosity which carried out homogeneity distribution of the oxide in the silver alloy porous body base used for this invention solid electrolyte fuel cells 7-20 of example 5 example 4 to the air pole side of a cel this invention solid electrolyte fuel cells 21-34 which have the structure shown in drawing 1 like an example 1 were produced, about this invention solid electrolyte fuel cells 21-34, the current density in 0.7V was measured, respectively, and the result was shown in Table 4.

[0039]

[Table 4]

種別		分散強化型銀合金多孔質体からなる空気集電体			0.7 Vにおける電流密度 (mA/cm ²)
		成分組成 (容量%)		気孔率 (%)	
		酸化物	銀合金		
本発明固体電解質型燃料電池	21	SiO ₂ : 8	本発明固体電解質燃料電池7で使用了銀合金 : 残部	93	563
	22	TiO ₂ : 13	本発明固体電解質燃料電池8で使用了銀合金 : 残部	93	532
	23	Fe ₂ O ₃ : 7	本発明固体電解質燃料電池9で使用了銀合金 : 残部	95	542
	24	NiO : 15	本発明固体電解質燃料電池10で使用了銀合金 : 残部	92	540
	25	MgO : 32	本発明固体電解質燃料電池11で使用了銀合金 : 残部	94	505
	26	CaO : 21	本発明固体電解質燃料電池12で使用了銀合金 : 残部	93	538
	27	SiO ₂ : 8	本発明固体電解質燃料電池13で使用了銀合金 : 残部	93	550
	28	TiO ₂ : 13	本発明固体電解質燃料電池14で使用了銀合金 : 残部	91	561
	29	Fe ₂ O ₃ : 7	本発明固体電解質燃料電池15で使用了銀合金 : 残部	93	559
	30	NiO : 15	本発明固体電解質燃料電池16で使用了銀合金 : 残部	94	571
	31	MgO : 32	本発明固体電解質燃料電池17で使用了銀合金 : 残部	94	526
	32	CaO : 21	本発明固体電解質燃料電池18で使用了銀合金 : 残部	92	543
	33	SiO ₂ : 8	本発明固体電解質燃料電池19で使用了銀合金 : 残部	93	574
	34	TiO ₂ : 13	本発明固体電解質燃料電池20で使用了銀合金 : 残部	91	572

[0040] Compared with the conventional solid electrolyte fuel cell 1 of Table 1 which produced this invention solid electrolyte fuel cells 21-34 which incorporated the air pole charge collector which consists of a dispersion-strengthening mold silver alloy porous body from the result shown in Table 4 in the conventional example 1, it turns out that the current density in 0.7V is improving sharply.

[0041] As alloy powder which excelled example 6 silver in high temperature strength, each has mean-particle-diameter: 2.1micrometer. SUS430 (a component presentation and Cr:17% are contained and the remainder is Fe and an unescapable impurity) shown in Table 5, SUS304 (a component presentation, nickel:9.3%, and Cr:18.4% are contained) the remainder -- a Fe and unescapable impurity, and nickel-10%Cr alloy and INCONEL600 (Cr: -- 15.5%) Fe: Contain 7% and the remainder is the nickel and unescapable impurity, and HEINZU alloy 188 (nickel:22%, Cr:22W:14.5%, and Fe:1.5% are contained). The remainder prepares Co and each atomization powder of an unescapable impurity, and fabricates using these alloy atomization powder. The alloy porous body which has the porosity shown in Table 5 by sintering in a vacuum at the temperature shown in Table 5 is produced. An air pole charge collector is produced by forming Ag deposit, after forming nickel plating substrate layer of the thickness shown in Table 5 at one side of these alloy porous body. this invention solid electrolyte fuel cells 35-39 which have the structure shown in drawing 1 like an example 1 using this air pole charge collector were produced, about this invention solid electrolyte fuel cells 35-39, the current density in 0.7V was measured, respectively, and that result was shown in Table 5.

[0042]

[Table 5]

種別		銀よりも高温強度の優れた合金粉末の種類	焼結温度 (°C)	銀よりも高温強度の優れた合金多孔質体からなる空気集電体			0.7Vにおける 電流密度 (mA/cm ²)
				気孔率 (%)	Niメッキ下地層 の厚さ (μm)	Agメッキ層の 厚さ (μm)	
本発明 固体電解質 型燃料電池	16	SUS430	1100	94	3	10	600
	17	SUS304	1100	91	3	5	554
	18	Ni-10%Cr	1100	92	3	5	574
	19	INCONEL600	1100	94	3	5	560
	20	ヘインズアロイ188	1100	94	3	5	571

[0043] Compared with the conventional solid electrolyte fuel cell 1 of Table 1 which produced this invention solid electrolyte fuel cells 35-39 incorporating the air pole charge collector which performed

nickel plating and Ag plating to at least one side of the porous body of an alloy which excelled silver in high temperature strength from the result shown in Table 5 in the conventional example 1, it turns out that the current density in 0.7V is improving sharply.

[0044]

[Effect of the Invention] since the oxide film was formed in the front face of the air pole charge collector which consists of a silver porous body of this invention, and a silver porous body -- silver -- a porous body -- an air pole charge collector -- the air pole charge collector which consists of a dispersion-strengthening type silver porous body, and a silver alloy -- a porous body -- an air pole charge collector -
- And the solid oxide fuel cell which incorporated the air pole charge collector which consists of a porous body which performed nickel plating and Ag plating to at least one side of the porous body of an alloy which excelled silver in high temperature strength, respectively From the place which shows the generation-of-electrical-energy property of 1.6 times or more compared with the solid oxide fuel cell incorporating the air pole charge collector which consists of the conventional platinum mesh It has the generation-of-electrical-energy property which was excellent even if it lowers to 900 degrees C or less and operated them, since it can operate at low temperature, and a use life can be prolonged and the ingredient of low cost can be used further, a manufacturing cost can be lowered, and it greatly contributes to development of fuel cell industry.

[Translation done.]